

1. In the recovery of ethylene from a feed gas comprising methane, ethylene, and hydrogen wherein the recovery comprises the steps of compressing and cooling the feed gas to condense a portion thereof, fractionating the resulting condensed feed gas liquid in at least one demethanizer column to recover a light overhead product comprising substantially hydrogen and methane, and recovering an ethylene-containing product from the bottoms stream from the at least one demethanizer column, wherein cooling and demethanization of the feed gas is provided by a refrigeration process comprising the steps of :

(a) compressing from a first pressure to a second pressure a gaseous mixed refrigerant stream comprising methane, ethane and/or ethylene, and propane and/or propylene having a preselected composition;

(b) cooling and partially condensing the aforesaid mixed refrigerant stream and separating a vapor refrigerant stream having an increased percentage of methane and a liquid refrigerant stream having an increased percentage of propylene and/or propane;

(c) cooling the vapor stream from step (b) to produce an at least partially condensed vapor stream and cooling at least the vapor portion thereof to produce in at least one step a subcooled liquid stream;

(d) flashing the subcooled liquid stream from step (c) to a third pressure which is above the aforesaid first pressure and at least partially vaporizing the resulting depressurized stream by indirect heat exchange with the demethanizer overhead to thereby provide refrigeration for the demethanizer condenser;

(e) cooling the liquid stream from step (b) and the liquid portion if any, of the aforesaid partially condensed vapor stream from step (c), flashing them to the aforesaid third pressure, and combining them with the at least partially vaporized stream from step (d) either before or after or both before and after the at least partially vaporized stream from step (d) undergoes further heating, to thereby form an at least partially vaporized combined stream having the aforesaid preselected composition;

(f) completely vaporizing the combined stream from step (e) by indirect heat exchange thereof with the feed gas to thereby provide refrigeration to cool the feed gas; and

(g) recycling the completely vaporized mixed refrigerant stream from step (f) to step (a).

2. The process of Claim 1 wherein in step (c) the entire at least partially condensed vapor stream is cooled to produce in at least one step the subcooled liquid stream, and in step (e) the entire cooled flashed liquid stream from step (b) is combined with the at least partially vaporized stream from step (d) before the stream from step (d) undergoes further heating to thereby form a combined stream having the aforesaid preselected composition.

3. The process of Claim 1 wherein in step (c) the entire at least partially condensed vapor stream is cooled to produce in at least one step the subcooled liquid stream, and in step (e) a portion of the flashed stream from step (b) is combined with the at least partially vaporized stream from step (d) before it undergoes further heating, to thereby form a first combined stream, which after further heating is combined with the remainder of the cooled depressurized stream from step (b), to thereby form a second combined stream which has the aforesaid preselected composition.

4. The process of Claim 1 wherein in step (c) the aforesaid vapor portion is cooled to produce in at least one step the subcooled liquid stream, and in step (e) the cooled flashed liquid portion of the aforesaid partially condensed vapor stream from step (c) is combined with the at least partially vaporized stream from step (d) before it undergoes further heating, to thereby form a first combined stream, which after further heating is combined with the cooled flashed stream from step (b), to thereby form a second combined stream which has the aforesaid preselected composition.

5. The process of Claim 1 wherein the feed gas comprises from 3 to 50 mole percent of methane, from 10 to 45 mole percent of ethylene, and from 5 to 50 mole percent of hydrogen.

6. The process of Claim 1 wherein the feed gas comprises cracked gas from a hydrocarbon cracker.

7. The process of Claim 6 wherein the feed gas comprises from 15 to 50 mole percent of methane, from 10 to 30 mole percent of ethylene, and from 5 to 25 mole percent of hydrogen.

8. The process of Claim 1 wherein the feed gas comprises the offgas stream from a refinery fluidized catalytic cracking unit.

9. The process of Claim 8 wherein the feed gas comprises from 3 to 35 mole percent of methane, from 20 to 45 mole percent of ethylene, and from 10 to 50 mole percent of hydrogen.